International Journal of Research in Advent Technology (E-ISSN: 2321-9637) Special Issue
National Conference "IAEISDISE 2014", 12-13 September 2014

Relevance of Applied Physics curriculum in Engineering Colleges of Himachal Pradesh: A Perception Study

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Abstract- Relevant and appropriate curriculum is one of the important constituent of any formal technical education programme. It should be so designed that it meets the requirements of present and future needs of world-of-work. The subject of applied physics is included in the engineering curriculum to help students understand the concepts of core engineering subjects, which in turn help them to apply engineering concepts in the real world. This paper analyzed the relevance of applied physics curriculum for teaching-learning of core-engineering subjects, as perceived by teachers and students of technical institutions. A survey method of research was conducted to take views of teachers and students. Cluster random sampling technique was employed to select sample of teachers and students. A questionnaire was designed to obtain views of teachers and students. One of the major findings of the study is that the subject contents of present applied physics curriculum in the four year engineering degree programme in the state of Himachal Pradesh is up to the mark in the teaching-learning of four engineering discipline's subjects viz. civil engineering, electrical and/or electrical & electronics engineering, electronics & communication engineering and mechanical engineering, whereas it is not that useful and relevant for teaching-learning of subjects of computer science & engineering and information technology engineering. In the paper educational implications are discussed which emerged from the findings of the study.

Index Terms- Applied physics, Curriculum

1. INTRODUCTION

Physics and technology are highly related. Physics deals with understanding of the natural world, while technology aims to apply this understanding into the man-made world. Technology might even be considered as the offspring of physics. Physics is involved in extending the knowledge base of various aspects of the natural world and phenomena by a systematic study, effective experimentation and authentic analysis; and probe why and how do things happen, but may not necessarily be interested in practical applications of these findings. Engineering is the discipline of applying physics model to the real world in order to accomplish a desired result.

Physics concepts are the basis for learning of engineering concepts. The studies carried-out by Lal (1994), Math (1998), Jain (2000) and by Dhawan (2003) point-out towards the up gradation and development of core competencies among engineering students at polytechnic and engineering college level. It can be achieved by upgrading and reframing curriculum of engineering disciplines from time-to-time as per the latest developments in science & technology and changing demands of the working environment.

The research studies carried out at NITTTR, Chandigarh (2003), and by Dhande (2009) specifically concerns to the curriculum issues followed in engineering institutions. These studies particularly concerns about the adequacy and adaptabilit of curriculum in present day needs of the work-place. They also tried to peep into the future requirements of upcoming engineers and to frame the curriculum which is futuristic also. The study at Indian Institute of Technology (IIT), Madras (Chennai) in the year 2007, also emphasized that learning of basic-sciences (physics, chemistry and mathematics) is of utmost importance for the engineering students, because engineering in its core is the practical extension of basic-sciences phenomena.

In the curriculum of engineering disciplines of Himachal Pradesh University, Shimla (to which all the engineering degree colleges in the state are affiliated) applied physics is one of the subjects taught for better understanding of core engineering subjects. The contents of the applied physics curriculum must be such that learning of concepts facilitates learning of core engineering subjects also.

2. OBJECTIVES OF THE STUDY

The objectives of the study were to:

i. To study the perception of teachers teaching core engineering subjects and students regarding the usefulness of present applied physics curriculum in teaching learning of their respective engineering disciplines.
ii. To study the perception of applied physics teachers regarding the adequacy of existing applied physics curriculum.
iii. To identify the topics which may be added or deleted from the present applied physics curriculum to make it more relevant.

3. METHODOLOGY

Survey method of research was employed to conduct the study.

3.1. *Sample*

Out of 17 engineering degree colleges in Himachal Pradesh, 6 were randomly selected to collect the data. A random sample comprising of applied physics teachers, teachers teaching core engineering subjects, students undergoing study in their eighth and sixth semester respectively were selected from six engineering degree colleges. Final sample included 17 applied physics teachers, 114 engineering discipline teachers from various disciplines and 259 engineering students of sixth and eighth semester from various disciplines.

3.2. *Development of Tools*

Two questionnaires were prepared, one for teachers and other questionnaire was prepared to collect the data from engineering students of the various disciplines. For the preparation of questionnaires, informal discussions were held with the applied physics teachers and core engineering subject teachers regarding various aspects of their respective disciplines curricula. The questions were framed keeping in view the objectives of the present study. The draft questionnaires were circulated among the applied physics and core engineering subject teachers for their comments and feedback. Keeping in view the suggestions of the teachers the final questionnaires were prepared.

4. PERCEPTIONS OF TEACHERS AND STUDENTS OF VARIOUS ENGINEERING DISCIPLINES REGARDING PRESENT APPLIED PHYSICS CURRICULUM

The analysis of the data collected from the teachers teaching core engineering subjects and the students of selected engineering degree colleges of Himachal Pradesh is discussed below:

4.1. *Usefulness of Applied physics Concepts in the Learning of Core Engineering Subjects*

A large number of teachers (89% to 94%) and students (78% to 93%) from the engineering disciplines of civil engineering, electrical and/or electrical & electronics engineering, electronics & communication engineering and mechanical engineering expressed that the background of Applied Physics concepts is very useful/useful in their teaching/learning of respective engineering disciplines. On the other hand, comparatively less percentage, 41% to 45% of the teachers and 46% of the students from computer science & engineering and information technology were of the view that the usefulness of present Applied physics curriculum in their respective disciplines is very less. The results are depicted in Fig. 1.

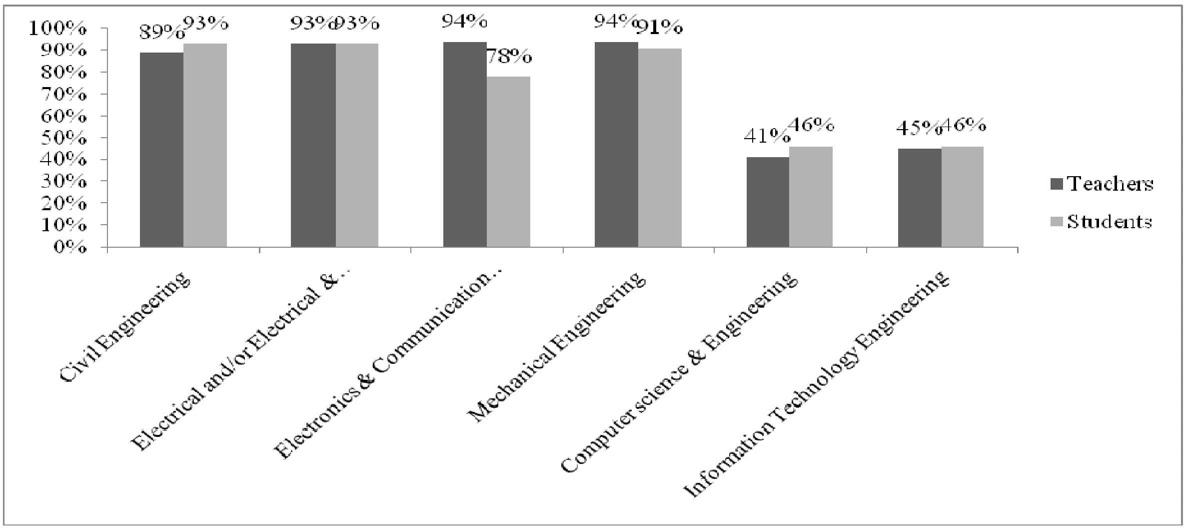

Figure 1: Usefulness of Applied Physics in Learning other Technical Subjects: Teacher & Student's Perceptions

4.2. *Command of Applied Physics concepts for learning other core engineering subjects*

48% to 68% of the teachers of engineering disciplines of civil engineering, electrical and/or electrical & electronics engineering, electronics & communication engineering and mechanical engineering were of the view that understanding of concepts of applied physics among their students helped them in teaching of core engineering subjects. Similar percentage of students was also of the view that understanding of concepts of applied physics helped them in learning core engineering subjects.

On the other hand, less percentage of teachers and students (26%) and (20%) of computer science & engineering and information technology respectively were of the view that understanding of concepts of applied physics did not helped them in learning core engineering subjects of their discipline. This may be because learning of subjects of computer science & engineering and information technology do not require much knowledge of physics concepts. The results are depicted in Fig. 2.

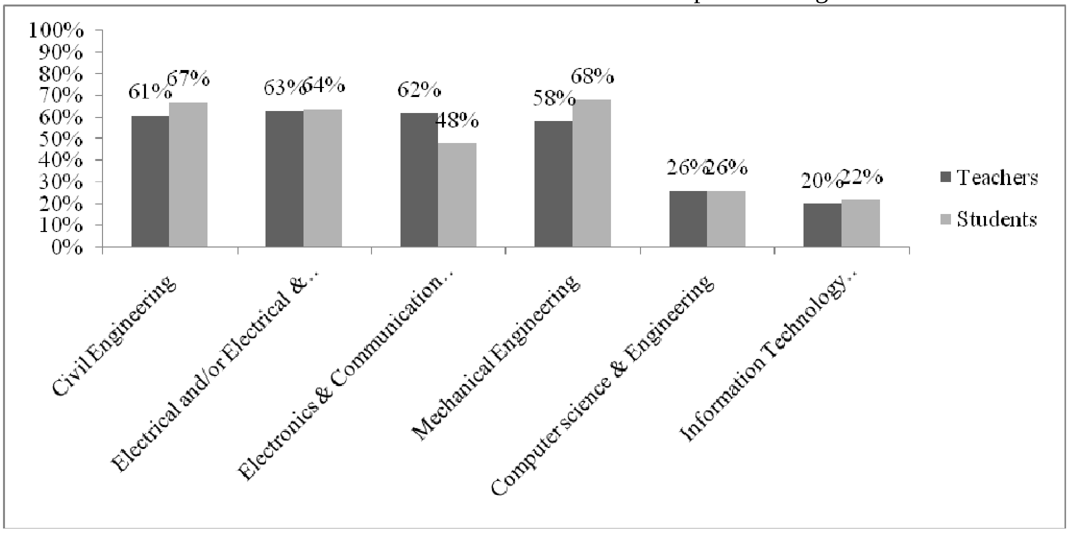

Figure2: Command of Applied Physics concepts for learning other Technical Subjects: Teacher & Student's Perceptions

4.3. *Core Engineering Subjects requiring high/low percentage of Applied physics Concepts*

The teachers and students of four engineering branches viz, civil engineering, electrical and/or electrical & electronics engineering, electronics & communication engineering and mechanical engineering indicated more number (five to seven) of subjects which were highly applied physics based. However, in comparison to that, the teachers and students of two engineering disciplines, computer science & engineering and information technology engineering mentioned less number (two to three) of subjects which were applied physics based.

Teachers and students of computer science & engineering and information technology engineering enlisted five to eight subjects which are less or very less applied physics based. The teachers and students of rest of the four branches, included in the study, enlisted comparatively less number of subjects (three to four) which they felt didn't require the learning of applied physics concepts. Names of such subjects for various engineering subjects are enlisted in Table 1.

4.4. *Addition and Deletion of Topics*

25% to 33% of the teachers and 19% to 29% of the students belonging to the engineering discipline of civil engineering, electrical and/or electrical & electronics engineering, electronics & communication engineering and mechanical engineering expressed that the topics/section(s) like Effects of forces, Shear forces, Kirchhoff's law, Laws of electromagnetism, Basic principles of digital & analog communication, Laws of thermodynamics, Concepts of robotics, Faraday's laws should be added to make it more relevant. These topics were suggested by teacher of various branches. Topics to be added are given in Table 2. They also expressed that the topics like Kronnig-Penny model, Quantum mechanics; and Thermionic emission (Richardson's equation) should be deleted from the present Applied Physics curriculum. As far as the applied physics teachers are concerned they also expressed the same topics, plus the introduction to nanotechnology and ultrasonic waves which may be included in the present applied physics curriculum. Comparatively a high percentage of teachers (74% to 77%) and students (71% to 73%) from the engineering disciplines of computer science & engineering and information technology expressed almost the same topics (as expressed by the teachers & students of above said four branches of engineering) should be deleted, but their choice of addition of topics is different and they expressed that the topics like basic concepts of mathematical & computational physics; and concepts of robotics and plasma physics should be added in the present applied physics curriculum to make it more relevant and useful to their respective engineering disciplines. In addition to these topics the teachers of applied physics expressed that the concepts of robotics should also be added to facilitate learning by the students of these two branches of engineering.

Table1. High and low applied physics based subjects of various engineering disciplines (engineering teachers view).

Extent of applied physics concepts required	**Response of the Teachers (in percentage)**					
	Civil Engineering	***Electrical and/or Electrical & Electronics Engineering***	***Electronics & Communication engineering***	***Mechanical Engineering***	***Computer science & Engineering***	***Information Technology Engineering***
Core engineering subjects, which are highly applied physics based.	I) Geotechnical engineering (58%) II) Highway engineering (56%) III) Dams (55%) IV) Fluid mechanics (52%) V) Fluid machines (50%) VI) Solid mechanics (44%) VII) Earthquake engineering (41%) VII) Earthquake engineering (41%)	I) Electromagnetic field theory (68%) II) Electrical & electronics measurement (53%) III) Power electronics (52%) IV) Power plant engineering (47%) V) Digital electronics (41%) VI) Electrical engineering materials & applications (40%) VII) Electrical power generation (39%) mechanics (44%) V) Digital electronics (41%) VI) Electrical engineering materials & applications (40%) VII) Electrical power generation (39%)	I) Electromagnetic field theory (63%) II) Optical fiber communication (59%) III) Radar & navigation (55%) IV) Communication theory (44%) V) Basic electronics (41%)	I) Fluid mechanics (51%) II) Material science & engineering (49%) III) Mechanical vibrations (44%) IV) Heat transfer (37%) V) Manufacturing technology (36%)	I) Electronic measurement & measuring instruments (49%) II) Optical communication (43%) III) Digital electronics (40%)	I) Digital communication (41%) II) Multimedia technology (37%) III) Wireless communication (21%)
Core engineering subjects which are less or very less applied physics based.	I) Hydrology (69%) II) Transportation engineering (58%) III) Water resource engineering (57%) IV) Civil engineering materials (51%) V) Irrigation engineering (50%)	I)Microprocessors (71%) II) Generation, protection & switchgear engineering (63%) III) Analog electronics (55%) IV) Communication engineering (54%)	I)Microprocessors (70%) II) Computer network (61%) III) Analog electronics (53%) IV) Digital signal processing (42%) V) Digital electronics (33%)	I) Operational research (67%) II) Total quality management (66%) III) Industrial engineering (61%) IV) Engineering graphics & drawing (61%) V) CAD/CAM (55%)	I) Discrete mathematics (91%) II) Numerical analysis & computer programming (84%) III) Data structure (80%) IV) Artificial intelligence (75%) V) Computer design (72%) VI) Theory of automata (67%) VII) Operating systems (67%)	I) Artificial intelligence (71%) II) Visual basic (70%) III) Web technology (66%) IV) System analysis & design (62%) V) Introduction to computer & programming in'C' (61%)

Table 2. Topics to be added to make Applied Physics curriculum more relevant for various engineering disciplines (engineering teachers view). (Values in the parentheses are percentage of teachers and students)

Addition of topics for learning core engineering subjects	**Response of the Teachers (in percentage)**					
	Civil Engineering	***Electrical and/or Electrical & Electronics Engineering***	***Electronics & Communication engineering***	***Mechanical Engineering***	***Computer science & Engineering***	***Information Technology Engineering***
Topics to be added in the present applied physics syllabus to help students learn core engineering subjects	I) Shear forces (49%) II) Effects of forces (46%)	I) Kirchhoff's law, Faraday's law, laws of electromagnetism (45%)	I) Basic principles of analog & digital communication (42%)	I) Laws of Thermodynamics (45%) II) General concepts of Robotics & fire arms (36%)	I) Basics of Computational & Mathematical physics (68%) II) Concepts of Digital electronics (61%) III) Basic concepts of LCD & Plasma physics (48%)	I) Basics of Digital electronics (66%) II) Fundamentals of Mathematical Physics (61%) III) History of Robotics (48%) IV) Concepts of Plasma Physics (39%)
	Response of the Students (in percentage)					
Topics to be added in the present applied physics syllabus to help students learn core engineering subjects	I) Effects of forces (59%) II) Shear forces & its diagrams (55%) III) Reflection & refractions (28%)	I) Kirchhoff's law (59%) II) Electromagnetic induction (57%)	I) Microprocessors (70%) II) Computer network (61%) III) Analog electronics (53%) IV) Digital signal processing (42%) V) Digital electronics (33%)	I) Applied-mechanics (57%) II) Robotics (51%) III) Concepts of fire arms (44%)	I) AM/FM communication (58%) II) Digital electronics & algorithm (51%) III) Wireless communication (44%) IV) LCD & plasma physics (40%) V) Computational & mathematical physics (38%)	I) Fundamentals of computational physics (67%) II) Concepts of robotics (60%) III) LCD & plasma physics concepts (47%)

4.5. Suggestions to Improve the Present Applied physics Curriculum

The engineering teachers & students suggested that, more emphasis should be given to the practical aspects, and numerical solving applications in the Applied Physics curriculum. They also suggested topics which may be included in the present Applied physics curriculum related to their respective fields of engineering & technology. However the Applied physics teachers suggested the following measures to improve the present applied physics curricula:

i. First semester syllabus is too lengthy and second semester is short as per the semester time available, so it should be reframed accordingly.

ii. Applied physics teachers included in the sample suggested that the first semester Applied physics syllabus should take into account the (10+1 and 10+2) physics curriculum.

iii. Practicals should be in both the semesters as is theory.

Engineering teachers and students were of the opinion that more emphasis should be given on the numerical solving practices in the applied physics curriculum.

4. EDUCATIONAL IMPLICATIONS

Following implications emerged from the findings of the study:

a. Curriculum is a dynamic process and needs continuing updating with the changes in the world of work. As-and-when the curricula of various subjects in the disciplines of civil engineering, electrical and/or electrical & electronics engineering, electronics & communication engineering, mechanical engineering, computer science & engineering and information technology engineering in the degree programme is going to be revised and/or changed then the change should also be made in the Applied physics curriculum.

The addition/deletion of topics will change with changes in core engineering subjects.

b. However in the present curriculum of applied physics following topics should be included: Basics of material sciences, Introduction to digital electronics, Basics of micro-particle physics, Ultrasonic waves, Laws of thermodynamics, Conceptual mathematical physics, Effects of forces, Shear forces, Kirchhoff's law, Laws of electromagnetism, Basic principles of digital & analog communication, Laws of thermodynamics, Concepts of robotics and Faraday's laws. The topics/sections like Quantum physics Kronnig-Penny model, Thermionic equation (Richardson's equation) and Crystal structure should be deleted from the present Applied Physics curriculum.

c. Applied physics curriculum should be bifurcated, one for the engineering discipline of civil engineering, electrical and/or electrical & electronics engineering, electronics & communication engineering, mechanical engineering and the other for the engineering branches of computer science & engineering and information technology engineering.

6. SUGGESTIONS FOR FURTHER STUDIES

Studies in the following areas may be conducted:

i. Curriculum analysis for other two applied-sciences subjects (applied-mathematics and applied-chemistry) can be undertaken.

ii. Studies on the curriculum analysis of various core engineering subjects may be conducted to examine its relevance in the world-of-work.

REFERENCES

[1] Dhande G. Sanjay, (2009). Design of an Engineering Curricula, Indian Institute of Technology Kanpur, Referred From http: // IIT Kanpur on 15 – 01 – 2011.

[2] Dhawan Vijayinder, (2003). A Curriculum Analysis for Three Year Diploma Programme in Electronics & Communication Engineering in Polytechnics of Punjab State, Thesis Submitted to TIET, Patiala.

[3] Gomber K.L., (1997). Fundamental Physics for +1 & +2, Pradeep Publications, Jalandher.

[4] Indian Institute of Technology Madras, Chennai, (2007). Report of the Task Force on B. Tech and Dual Degree Curriculum, Referred from http: // IIT Madras on 15 – 01 – 2011.

[5] Jain Bimal Parshad, (2000). Applied Chemistry for Diploma Programme – An Analytical study of Relevance of Topics, Thesis submitted to TIET, Patiala.

[6] Lal Inder Mohan, (1994). Designing curriculum for working Mechanical Engineering Technician with Reference to Electronics and Computer Applications. Thesis submitted to TIET, Patiala.

[7] Math D. Shivarajayya, (1998). A Critical Analysis of Curriculum for Electronic Engineering in Three Year Diploma Programme in Polytechnics of Goa State, Thesis Submitted to TIET, Patiala.

[8] National Institute of Technical Teachers' Training and Research, (2003). Revision of All the Curricula of Various Diploma Programmes in Haryana.

[9] Science Engineering & Technology, (2010). Relationship, Referred from www.Google.com on 10 – 12 – 2010.

[10] Technical Education in Himachal Pradesh, (2010). Department of Technical education, Referred from www.Himachal.gov.in on 10 – 12 – 2010.